Blockchain Technology Enabled Framework for Residential Property Transactions in Smart City

SHORT SYNOPSIS

Submitted partial fulfillment of the requirement of the degree of

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by

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I hereby declare that the short synopsis entitled "Blockchain Technology Enabled Framework for Residential Property Transactions in Smart City" being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in the Department of Computer Science and Technology under the School of Engineering of Manav Rachna University, Faridabad during the academic year 2024-25.

It is the work that is expected to be carried out under the supervision of Dr. Sanjay Singh and co-supervision of Dr. Mohit Agarwal.

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This is to certified that the short synopsis entitled "Blockchain Technology Enabled Framework for Residential Property Transactions in Smart City" is an original piece of work done by research scholar Nitesh Rohilla under the supervision of Dr. Sanjay Singh and co-supervision of Dr. Mohit Agarwal for the degree of Doctor of Philosophy in the Department of Computer Science and Technology of Manav Rachna University, Faridabad during the academic year 2024-25.

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ABSTRACT

Real estate sector contribution in India's GDP is 6-7% and also rank 2nd in employment creator after agriculture, however this sector has not been considered as transparent and trustworthy because of various issues like inappropriate data, involvement of black money, high involvement of middle man like agents and brokers, data availability in across departments and so on. Like any other sector, real estate sector is also implementing disruptive technology not only to improve the business and operations but also try eliminate the aforementioned challenges. Technology would play a significant role in boosting the trust amongst all the stakeholders and improve the decision-making process. Technology such as blockchain can help the buyer smooth and hassle-free transaction process in residential property purchase in smart cities. Property information can be easily stored in the blockchain network and can be seen by all the stakeholder using the decentralization feature. Immutability feature of blockchain will restrict the use to temper or change the property information. Smart contract will help the stakeholder to verify the authenticity of data make the transaction process easier. Smart contract will also help in automate the transaction process like transfer of title, reduce the transaction time and also eliminate the requirement of middleman. Implementation of blockchain technology in property transactions in smart city will ease out the overall transaction process and help the users like seller, buyer, authority, lawyer etc.

This study intends to provide a unique framework for residential property transaction utilizing Ethereum, extensively used to generate smart contracts using solidity programming language. Beneficial for an ecosystem in smart cities where various blockchains may interact, Hyperledger Fabric a permissioned blockchain architecture offers a security control and polkadot makes it simpler for different blockchains to engage with one another. The objective is to enable buyers, sellers, regulatory authorities and other important players to adopt the technology by means of a user-friendly interface.

Keywords: Blockchain Technology, Smart City, Transaction, Real Estate, Urban Planning

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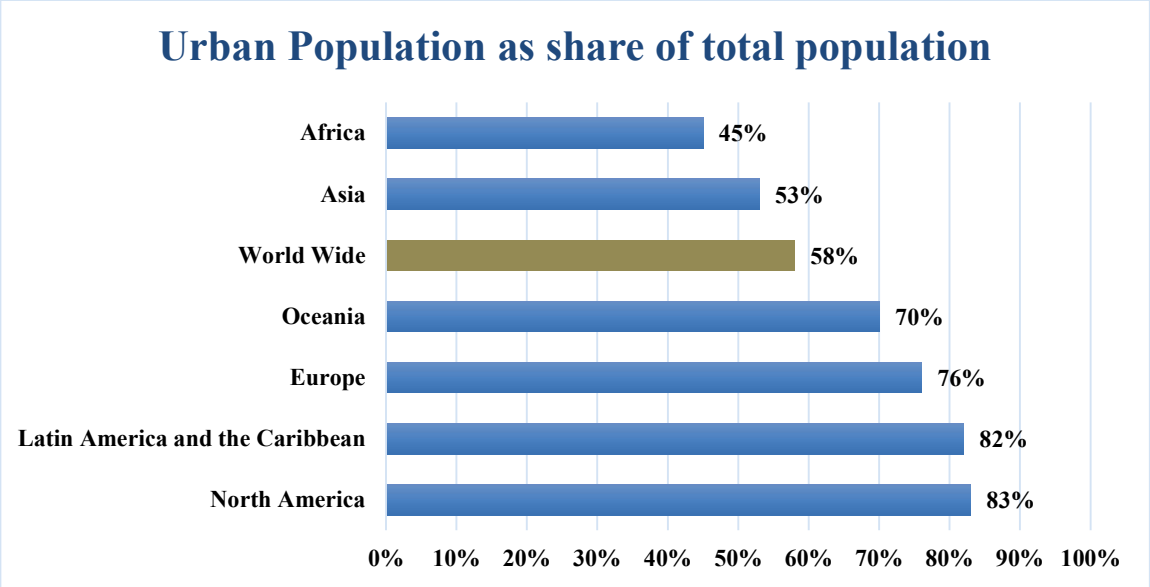
1. Introduction

Six to seven percent of India's GDP comes from the real estate sector which is the country's second-largest employer. People living in cities in India has significantly surge in last decade because of migration from rural areas to the urban cities for better jobs, medical facilities, good education and to increase their social standards. According to World Urbanization Prospects report, world's population would increase from 54% in 2020 to 65% by 2025 who lives in urban cites which is a significant increase of 11% [1][2]. There is always high demand of houses in urban cities because of migration and high population density. People find it difficult to buy their own houses because of various issues like double selling, inappropriate property information, large portion of black money involved, involvement of middle man like agent or broker etc [3]. Consequently, the decision-making is greatly influenced and the public does not trust the existing property management system, which causes lack of openness in this industry [4]. Encouragement of a more sustainable, open, and efficient real estate company calls for the integration of government agencies, technology, and other players. Blockchain and digital platforms among other technological developments help compliance and regulation by simplifying procedures and raising openness. Working with government agencies guarantees legal compliance and helps to ensure sustainable urban growth. Involving developers, investors, and community people helps to create more inclusive plans and fresh ideas that satisfy a variety of demands and foster confidence [5]. The collaborating approach enhances resource usage, speeds project approvals and encourages more equitable and informed real estate decision-making.



Source: S. Galan, "Urbanization rate by continent 2025 | Statista." Population Reference Bureau, Feb. 12, 2025. Accessed: Feb. 19, 2025. [Online]. Available: https://www.statista.com/statistics/270860/urbanization-by-continent/ [6]

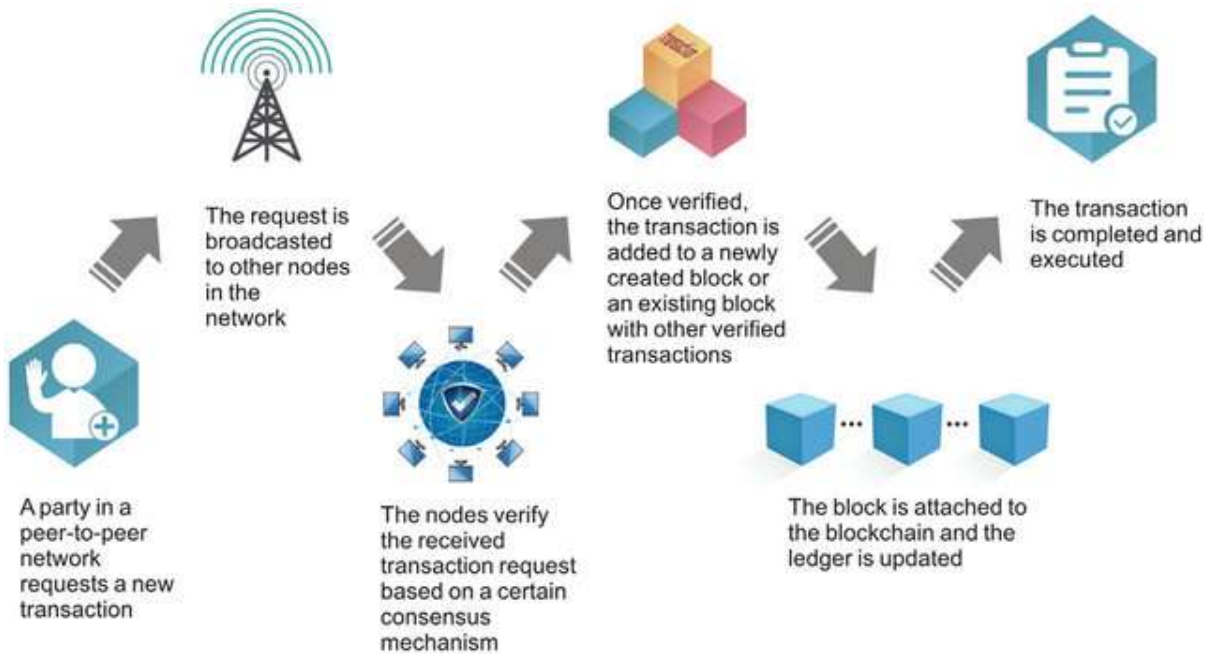
Figure 1: Share of Urban Population Worldwide in 2023

1.1 Blockchain Technology

Blockchain technology was originally envisioned as the base for Bitcoin but has matured into one of the most powerful technologies with applications far beyond crypto currency [7][8]. This technology offers the potential for highest levels of security, transparency and efficiency within a diverse range of disciplines. Blockchain is a distributed ledger that safely and securely records transactions on multiple computers. After each transaction is validated by a consensus process, it is added into a "block". When put together in the right order these blocks form a "chain" and hence the term "blockchain". Because of its distributed nature and the fact that no one person controls the entire chain, blockchain is obviously resistant to fraud and manipulation.

Decentralization, consensus methods, cryptographic protection and smart contracts are the core components of blockchain. In contrast to conventional centralized systems run by a single authority, blockchain functions on a decentralized network of nodes. Because each node has a copy of the whole blockchain, security is much improved because data is not stored in one location [9].

To append a block to the blockchain, there must be a consensus of the network. To achieve this goal, Proof of Work (PoW) and Proof of Stake (PoS) consensus mechanisms are used. These are the techniques that establish agreement amongst all participants on how valid the transactions are thus eliminate fraudulent actions and double spending. Blockchain uses encryption techniques to ensure data security. Each block holds a timestamp, transaction data and an encrypted hash of the previous one. The bitcoin hash and linking of blocks to form a chain ensures blockchain stability and prevents tampering [10]. Ethereum based smart contracts can be executed automatically if the all the condition are met in the written code. Introduced by the Ethereum blockchain, smart contracts are ones that could run autonomously depending on the parameters stated in code. When certain criteria are satisfied they enforce and execute agreements automatically so eliminating the need on intermediaries and improving efficiency [11].


A party in a peer-to-peer network requests a new transaction
The request is broadcasted to other nodes in the network
The nodes verify the received transaction request based on a certain consensus mechanism
Once verified, the transaction is added to a newly created block or an existing block with other verified transactions
The block is attached to the blockchain and the ledger is updated
The transaction is completed and executed

Source: F. Lumineau, W. Wang, and O. Schilke, "Blockchain governance-A new way of organizing collaborations," Organ. Sci., vol. 32, no. 2, pp. 500–521, 2021 [12]

Figure 2: Blockchain Function

Blockchain technology can transform several sectors due to its decentralization, security and transparency. The real estate market, healthcare, supply chain management, banking and other

related industries stand to benefit from these revolutionary applications. Even with the obstacles still present. Blockchain technology appears to have a promising future as its use and improvements continue. The digital economy will depend on blockchain as we discover and use it.

1.2 Smart City

A "smart city" uses digital technology to produce an efficient, sustainable and high-quality urban environment. These urban areas employ big data analytics, AI and IoT devices to streamline resource management, improve infrastructure and provide public services in a timely manner. The Smart Cities Mission, a massive initiative launched by the Indian government in 2015, has helped to spread the idea of "smart cities" all throughout the nation. This project is designed to help urban innovation and sustainable development by revamping 100 cities all throughout the country [13][14].

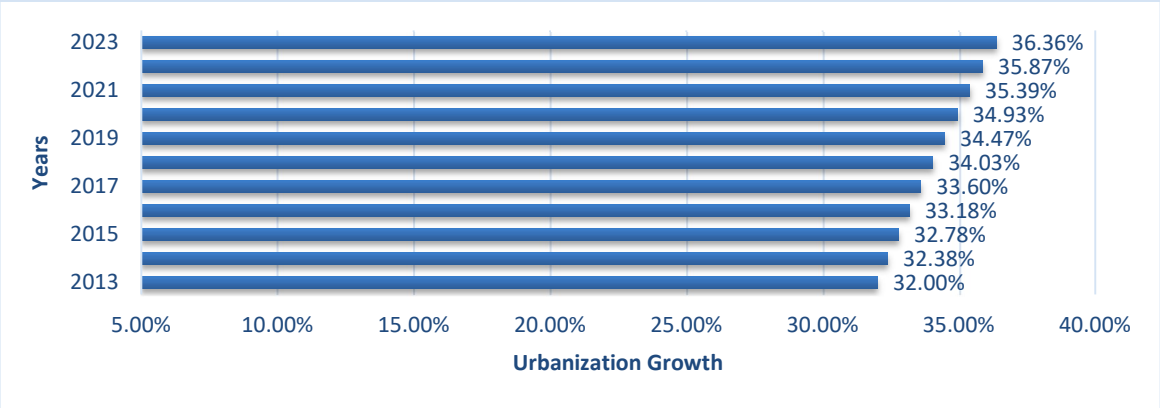
Targeting the various problems brought about by India's increasing urbanization, resource constraints, overcrowding and inadequate infrastructure, the Smart Cities Mission seeks to address the mission's goals include economic activity, environmental sustainability, smart solution-based urban planning and government based on clever ideas. For this project, some of the main areas of focus include smart housing, smart energy, smart surroundings, smart transportation and lifestyle enhancement [14][15].

Various critical elements, including infrastructure readiness, economic potential, population, urbanization trends, government policy support, technology and innovative ecosystem combined with a thorough checklist of prerequisites that must be followed to ensure successful shortlisting, let cities excluded from the Smart City Mission fail to meet the necessary criteria. The participating cities which have satisfied all prerequisites as mentioned above are selected for the next process, they must have to undergo with a competitive process amongst all the selected cities, this mandatory requirement or the checklist are the major reasons of some cities to be excluded from this race thus eliminating from the competition [16].

In conclusion we can say that smart city mission started by Government of India is to make self-sustainable country. The future aim is to improve the quality life of citizens of India by solving all the urbanization challenges through technology and innovations through smart city mission we as a country good improve on social inclusion environmental sustainability and economic development there are major cities which are currently walking on the city the city is improvement like Allahabad which is now called Prayagraj is seriously emphasise on citizen service financial district is being constructed by Gujarat which is also known as the land of the lines and legends significant work has been done towards smart waste management and smart energy I Chennai rest of the nominated cities like Surat, Jaipur, Indore, Pune, Bhuvneshwar and Ahmedabad are also progressing in the same way and indeed they will achieve and develop self-sustainable cities.

2. Motivation

Smart cities have been developed all around the world and are increasing to provide better place to live for people and to provide a secure and sustainable environment. Smart cities provide a wide range of creative possibilities by using technologically driven infrastructure. Regarding transaction speed, security, safety, deal flexibility, the real estate sector is still in its infancy [17]. As the data below shows, urbanization in India has increased by more than 4% throughout the previous 10 years. People are thus migrating from rural regions or Tier 2 or Tier 3 cities to big cities in pursuit of better job, education and safety [18].



Sources:O'Neill, A. (2025, February 13). India - Urbanization 2023 | Statista. India; World Bank. https://www.statista.com/statistics/271312/urbanization-in-india/ [18]

Figure 3: Urbanization Growth in India

Conventional property management techniques are riddled with inefficiencies such as high transaction costs and a lack of transparency that not only causes delays in transactions but also involves mediators and black money which raises the price of the property unnecessarily [19]. Aforementioned complications can be address by blockchain technology because of its distributed and immutability features. Blockchain also ensures data confidentiality safety and security openness and time stamped document. It also eradicates the requirement of middleman and make the entire transaction process very simple. Even though knowing potential benefits of blockchain technology as of now there is no significant model has been developed for utilising blockchain technology transactions specifically in India.

Solid framework should be created by researchers in the existing body of research to solve this huge disparity using blockchain technology to improve accuracy, transparency and security of real estate transactions in smart cities. Suggested framework will significantly add knowledge to the academic research as well as practical applications will ensures the acceptance of creative technology in real estate property management solutions.

3. Literature Review

3.1 Blockchain Technology

In the last few years interest in blockchain technology has grownup globally, a lot of research has been conducted to understand its possible usage, challenges and opportunities Many studies on its various applications have been conducted in recent years which helps the researchers to understand the technology better. A comprehensive review of the literature shows that the distributed and secure features of blockchain technology provide transforming possibilities for several sectors, including supply chain management, healthcare, finance and more others [20][21]. Literature research has suggested several approaches to address issues in several fields of application, which are underlined further.

3.2 Smart City

Smart Cities are a key urban development model that addresses fast urbanization, increasing populations and conservation of the environment. Over time, the definition of a "smart city"

has evolved to incorporate more broadly ideas including technology, governance and public involvement. Using information and communication technology (ICTs) would help to improve urban infrastructure and services mostly [22]. Over a period of time sustainability, resiliency, and inclusivity were added to the concept [23].

The smart cities of India are oriented on the general expansion of the nation's economy. Although the development of smart cities in India is expected to have a major influence on the direction of society, its focus is on satisfying the needs of homebuyers of today. Among the fundamental elements of smart cities are inexpensive housing, especially for the underprivileged, sustainable environment and citizen safety and security, consistent water supply, suitable electrical supply, secured effective urban transit. Several essential components define a smart city such as intelligent infrastructure, intelligent government, intelligent economics, intelligent environment and intelligent lifestyle.

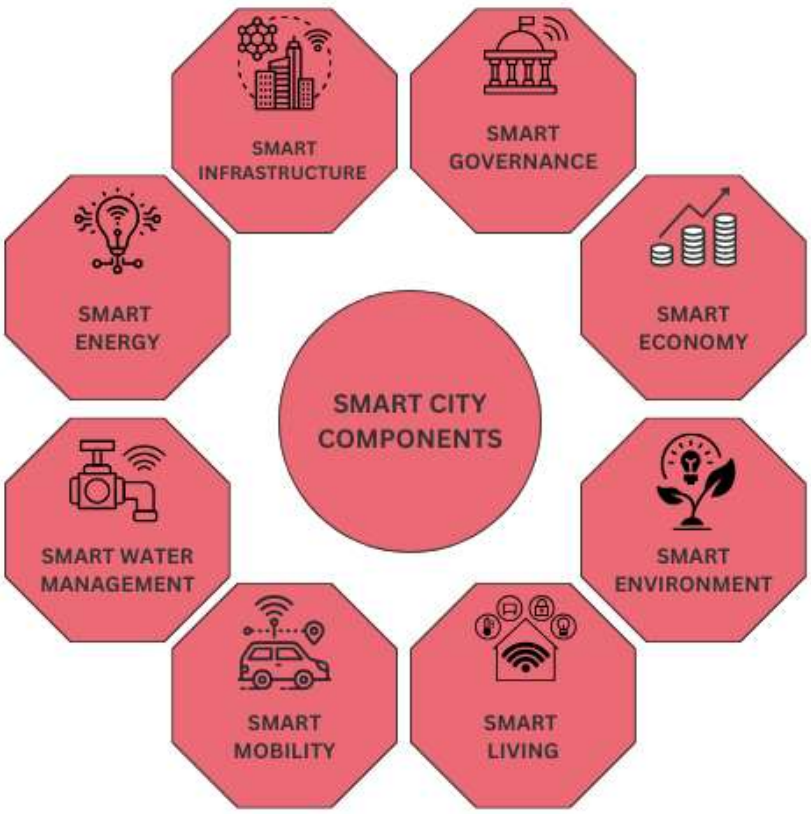


Figure 4: Smart City Components

Table 1: smart city component features

S.no.	Component	Feature
1	Smart Infrastructure [24]	Increasing effectiveness and connectivity requires integrating information and communication technology into urban infrastructure. There are a few examples of smart water management, intelligent transportation systems and smart grids are a few examples.
2	Smart Governance [25]	Digital technology is used to improve public services, transparency and citizen involvement in smart government. In this context the use of open data projects and e-government services is crucial.
3	Smart Economy [26]	The smart economy aims to encourage innovative thoughts, business expansion and growth in the economy. It covers the creation of digital platforms as well as intelligent manufacturing.
4	Smart Environment [27]	It includes utilization of technology to efficiently track and control natural resources, minimize pollution and support for environmental friendly energy alternatives.
5	Smart Living [28]	People's quality of life can be improved through smart safety, education and healthcare programs.
6	Smart Mobility [29]	Public transportation can be optimized using smart mobility. Intelligent Traffic Management is proposed in this. EV charging infrastructure can be developed to promote sustainability.
7	Smart Water Management [30]	Its goal is to encourage water recycling and rainwater collection. We can promote an IoT-based water distribution system.

8	Smart Energy [31]	It emphasizes the use of solar and renewable energy sources and incorporates energy-efficient technologies and smart grids.

Source: Author's Compilation

Literation study discussion: Blockchain Technology and Smart Cities

Sun, J., Yan et al. (2016). Blockchain-based sharing services: What blockchain technology can contribute to smart cities [32] Presented a theoretical framework that relied on three key components: human, technology and organization. According to prior research these three aspects are commonly utilized to express and comprehend the smart city notion. The author explains that there is a symbiotic link between humans, technology and organizations where humans utilize technology in their daily lives. The author highlights the need to share services in the smart city where technological resources are pooled to enhance municipal infrastructure and improve services for the residents. Based on the conceptual framework, the author concluded that blockchain-based service sharing might significantly aid in the creation of smart cities.

Kumar et al. (2018), "Smart neighborhood: A TISM approach to reduce urban polarization for the sustainable development of smart cities [33] TISM model was developed as a way of creating sustainable smart cities. The author selected crucial elements for intelligent neighborhoods and employed a sample t-test to authenticate the suggested criteria from the literature research. The technique of whole interpretive structure modeling is employed to determine the intricacy of the connection between crucial components. Additionally, a cross-impact matrix is utilized to identify the primary driving force for the construction of smart neighborhoods. This research also emphasizes the significance of public involvement in the development of local infrastructure, considering their preferences and a systematic hierarchy of all aspects that influence the creation of a smart city.

P. F. Wong et al. (2020), "Potential integration of blockchain technology into smart sustainable city (SSC) developments: a systematic review" [34] Conducted a thorough literature study to gain a comprehensive understanding of the past research carried out on smart

cities. The author's review and research concluded that several application domains may be included in the development of smart cities, including smart governance, smart transportation, smart asset management, smart utility systems and smart logistics. The literature research indicates that the predominant application fields are smart governance (25%), smart mobility (20%), smart utilities (19%), smart healthcare (17%), smart asset management (10%) and smart logistics (9%). The author revealed that blockchain technology can enable the development of a smart sustainable city.

Dewan et al. (2020), "Use of blockchain in designing smart city" [35] Proposes a proof of concept for utilizing blockchain technology to create a smart contract that records property transactions. The author selected key elements such as Decentralized Apps (DApps), MetaMask and simulation to develop proof of concept. The Ethereum platform has been utilized to establish the blockchain network for recording digital transactions associated with the purchase, sale, or rental of a property. A smart contract is immutable and cannot be tampered with. This improves the overall security of the process, leading to a substantial decrease in the probability of fraud to a negligible level.

Khattak et al. (2020). "Dynamic pricing in industrial internet of things: Blockchain application for energy management in smart cities" [36] provided an overview of the Smart Grid (SG) and its function in the control of distribution and generation of power. As per the customers demand smart grid supplies the electricity to the distributor. Real time monitoring is executed by Smart Grid and establish a balance between demand and supply it also makes a connection between the utilities and customers which significantly reduce the wastage of electricity and energy consumption.

Based on real time demand and supply smart contract calculates dynamic pricing as well as calculate the energy demand at that time it also automates the bidding process. The name of this concept is as follows twenty inhabitants, one bank, and one utility: an energy generating unit. Residents can create electricity through smart contracts and the bank swaps coin/cash for trans-actions and sells extra units to other residents. All the units are stored on the blockchain network for consumers to verify. It exhibits the available units which are used for computing the price based on requirement, supply and time. Residents must select the threshold units

required to satisfy future energy needs. Not a single electrical transaction can occur unless the terms of the smart contract are fulfilled.

Pradhan et al. (2021), "Smart contracts for automated control system in Blockchain based smart cities" [37] discussed the utilization of blockchain technology in smart cities is increasing. Offering a multitude of advantages to residents and enhancing their overall well-being. It offers justifications of several intelligent services that show the degree of sophistication in a city such intelligent healthcare, intelligent transportation, intelligent building monitoring, intelligent parking and intelligent governance. Cities are using IoT devices to centralize data collecting and sharing among verified users. But centralized systems might be prone to failure because of a single point of failure, data loss, network inconsistencies and cyberattacks. Blockchain-based smart contracts offer consumers a distributed and secure environment. Intermediaries are removed using distributed architecture using Ethereum platform to automatically execute the smart contract amongst the trustworthy parties. The author assessed real use cases for PoS which includes smart building monitoring and smart healthcare in the proposed Ethereum based architecture. Open-source Java application (Remix) is used by the author to test the smart contract. Meta-Mask technology is used to identify the users in the smart city. Truffle platform was used to trace the transaction in architecture. It verified with ether scan. Past research examined the transaction cost related to Gas and double expenses activities, with more focus on hash value.

Asif, M. et al. (2022). "Blockchain-Based Authentication and Trust Management Mechanism for Smart Cities" [38] investigated the security and privacy issues related to IoT devices. Due to the resource limitation the management of Internet of Things (IoT) based devices which uses traditional methods are considered as untrustworthy. Since IoT based systems produces a massive amount of data so it is very critical to create the architecture which is extensive secure and ensure the privacy of people. Authentication and Authorization for Con-strained Environments (ACE) blockchain framework and Object Security Architecture for Internet of Things (OSCAR) object security architecture is proposed by author. Proposed method and framework provide safety amongst all IoT devices. The accepted blockchain model when executed on Ethereum network ensures the architectures feasibility and accuracy. Smart city environment was built using Pi B+ plus and Raspberry and Node.js server was used to build the

authentication in the architecture. Mocha and Chai frameworks were used to evaluate the overall performance of the system. The simulation results show that although the average communication time rises with client count, the authentication response time stays within 100 ms, thereby verifying the effectiveness of the suggested methodology.

Biswas et al. (2023), "Securing smart cities using blockchain technology", In order to improve smart city development [39] carried out extensive study and compiled all relevant studies about the use of blockchain technology for digital identity. Based on the results of this investigation the utilization of Blockchain for digital identification is now in its nascent phase. Despite the scarcity of high-quality papers pertaining to this latest technology it is evident that the industry has a significant interest in this field. The primary sources of information for this subject area consist of white papers, technical discourse papers authored by subject matter experts and industry reports. To improve Digital Identity services the sector is now among the top companies actively investing in and wagering on the usage of Blockchain technology.

Table 2: Literature Review

Author	**Methodology**	**Results**
A. Jreisat, [5]	Literature based study	The study found that blockchain technology might streamline real estate transactions and improve trust, but certain challenges must be overcome. Regulatory clarity, technical uniformity and stakeholder awareness are major issues. To truly realize blockchain's promise in real estate, industry, government and technologists must work together.
J. Sun et al., [32]	Triangle conceptual framework	Using human technology and organizational elements can

		contribute to developing smart city sharing services
P. F. Wong et al., [34]	Systematic literature review	Literature analysis results show that blockchain technology could assist in developing smart sustainable cities in various areas like governance, mobility, healthcare, utility etc. social, environmental and economic sustainability can also be achieved using blockchain technology.
S. Dewan, [35]	Proof of concept + Ethereum platform	Proof of concept and Ethereum platform were used to provide a solution for paperless transaction which is called smart contract and used to store the property related information on the decentralized network which can't be tempered.
H. A. Khattak et al., [36]	Real use case (20 residents, 1 bank, 1 utility)	The study's findings demonstrate that blockchain technology may be used to manage energy in smart cities and assist in real-time, dynamic pricing that takes supply and demand into account.
N. R. Pradhan, [37]	Use case + Proof of stake + Keccack 256	Ethereum employed proof of stake to facilitate the transaction management. An analysis of transaction costs concerning gas and double spending behavior was performed utilizing the Keccak 256 hash. The results indicate that the chance of a double spending assault peaks at

		42% when hashing power exceeds 55%.
S. Biswas et al., [39]	Framework enabling independent service providers to execute local transactions without burdening the blockchain network. The authors further performed simulations of the interoperability network.	The study concludes that the proposed blockchain-based framework effectively addresses interoperability challenges in smart city services. By enabling secure and efficient local transactions, the framework reduces the burden on the overall blockchain network, enhancing scalability and optimizing memory usage. This approach facilitates seamless integration of diverse services within a smart city, promoting efficient e-governance and improved civic life.
P. Garg et al., [40]	Method of fuzzy analytical hierarchy process applied to factor ranking. Review of the extensive literature and expert opinion for factor identification.	The results highlight that the organizational dimension is the most crucial factor influencing blockchain technology implementation in banks among the other aspects. The study offers a disciplined framework for banks and financial companies' decision-makers to evaluate and rank these elements. Such a structure can help businesses develop strong plans for the application of blockchain technologies, therefore improving operational effectiveness and a competitive edge.

A. Marengo, [41]	Review of systematic literature covering 1786 publications. Analyzed personal and corporate viewpoints on blockchain acceptance.	Although expenses and regulatory obstacles are ubiquitous, technical knowledge varies depending on sector. Adoption of blockchain depends partly on local laws and culture.
M. Stefanović et al., [42]	Smart contract based on Solidity for complex LAS conditions. Ethereum was used for the solution.	The study provides a Solidity-based smart contract solution to land administration system challenges such data manipulation, lengthy transaction registration delays and double spending and enhancing system state accuracy. The smart contract implements an ERC-20 and ERC-721 token-based programming interface to support land administration use cases like sharing ownership, transferring partial ownership, splitting or merging real estate and restricting real estate trading.
O. Uchani Gutierrez, [43]	Analytic Hierarchy Process methodology breaks down complex problems into simpler ones. The Similarity to Ideal Solution Ordering Method. The ToPSIS (Technique for Order of Preference by	Smart contracts in blockchain enhance property transaction security in smart cities. Smart homes verify ownership, reducing fraud and ensuring individual security

	Similarity to Ideal Solution) paradigm implements smart co- ntract in Solidity programming language.	
C. Lin et al., [44]	Polynomial-time solvable algorithm	Findings indicate that the suggested model may be used in an actual smart city's Intelligent Transportation System (ITS). To determine the likelihood of congestion in the transportation network, a polynomial-time solvable method was employed.
L. Huo et al., [45]	ARIMA (Autoregressive Integrated Moving Average) Model	Result of the ARIMA model shows that proposed security measurement approach is feasible and very much effective
Y. Yang, [46]	Short Term Fourier Transform (STFT) and Auto Regression (AR) Model	The traffic prediction scheme was used based on STFT. After simulation the proposed model worked well in predicting the error of network traffic.
B. K. Mohanta et al., [47]	Questionnaire Survey+ factors validation, TISM	Made a system based on TISM approach which was found significantly helpful to the city planners, governments to make ICT based city infrastructure which can boost the life expectancy, fast delivery etc.
K. Biswas, [48]	Security Framework	Improved dependability, fault tolerance, rapid and efficient operation

		and scalability by providing a secure communication network.
J. M. Avalos, [49]	Systematic mapping review	The study results show that the use of blockchain in digital identity can help in the healthcare sector, governments, industries and local bodies to verify the citizens' identities on each online transaction in real time with a time stamp which eliminates the chances of fraud.

4. Description of Broad Area

The implementation of blockchain technology in property transactions signifies a substantial change in the execution of real estate deals particularly within the technological infrastructure of smart cities. This extensive study domain encompasses numerous critical elements.

Investigating the essential principles of blockchain technology including its decentralized structure, immutability, transparency and security features. It explores the mechanism by which blockchain's distributed ledger system guarantees the integrity and authenticity of data by preventing unauthorized alterations and enabling easy verification.

Analyzing traditional property transactions with specific attention on matters such as bureaucracy, risks of fraud, expensive transfer fees and long processing periods. This paves the way for realizing the potential benefits that blockchain technology may provide. Potential of blockchain technology to optimize property transactions by offering a transparent, secure and efficient platform. The following items are included:

- Contracts that are self-executing and automated are called smart contracts. No intermediaries are required since the conditions of the transaction are enclosed directly into the code.
- Decentralized ledgers are utilized to secure document ownership and transaction history guaranteeing the integrity of data and deterring fraudulent activities.

- Asset tokenization refers to the conversion of property rights into digital tokens facilitating more efficient transfers and enabling fractional ownership.

4.1 Smart city benefits using blockchain technology

- Enhancing Transparency: Offering a publicly available easily accessible record of every transaction.
- Enhancing Efficiency: Minimizing the duration and expenses related to property transactions.
- Improving Security: Safeguarding against fraudulent activities and unauthorized modifications.
- Enabling Interoperability: Facilitating smooth integration with other smart city systems and services.

5. Objectives of Research

RO1 To investigate the role of blockchain technology in enhancing the transparency and security in smart cities in India.

RO2 To analyze the factors that affect the adoption of blockchain technology in property transactions in smart cities.

RO3 To develop a blockchain-based framework for transparent, secure and efficient residential property transactions in smart cities.

RO4 To compare and validate the proposed framework against existing frameworks for residential property transactions in smart cities.

6. Methodology to be adopted

The approach for this research consists of many important steps beginning with a complete literature analysis to identify the major ideas, trends, problems and possibilities in implementing blockchain technology to property transactions in smart cities. This study will encompass academic articles, industry reports and white papers specifically concentrating on

the integration of blockchain technology in real estate and smart city development. The review will find basic concepts like blockchain's role in registering property, transferring ownership and the use of smart contracts and decentralized identity systems. Furthermore, the evaluation will investigate new developments in the real estate industry's embrace of blockchain technology emphasizing creative uses and possible implications for smart city infrastructure.

After reviewing the literature, the study will examine case studies and pilot projects that have already been completed that use blockchain technology to facilitate real estate transactions in smart city settings especially in developing nations. This study will assess the elements that contributed to the success of the lessons that were learnt and the problems that were encountered by these projects. It will gather insights from the methods used, the technology deployed and the outcomes that were accomplished. The selection of case studies will be based on their relevance, regional variety and the level of blockchain integration. This will offer a full grasp of the practical uses and constraints of blockchain in this context.

The research will develop surveys to collect insights from a variety of stakeholders involved in property transactions, such as property owners, buyers, sellers, real estate agents, brokers, government officials and blockchain experts. The objective of these surveys is to ascertain

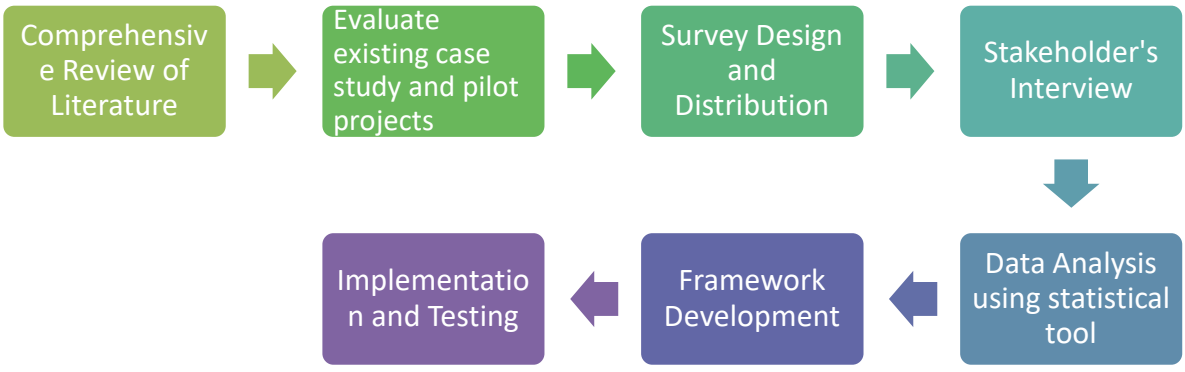


Figure 5: Methodology to be adopted

the expectations, experiences and perspectives of stakeholders with respect to the utilization of blockchain technology in property transactions. The research will undertake interviews

with key stakeholders, alongside surveys to gain a more thorough knowledge of the potential and problems related to blockchain adoption in this area.

Analysis of the interview transcripts and survey responses will be conducted to identify common themes, concerns and opportunities. This analysis will contribute to the creation of a framework for blockchain-based systems using Solidity Programming, Ethereum or Hyperledger Fabric depending on the specific requirements of the framework that are more specifically designed for property transactions in a smart city situation. The framework will incorporate features such as property registration, ownership transfer, smart contracts, and decentralized identity which were specifically designed to address the requirements and challenges identified in the earlier phases of the research.

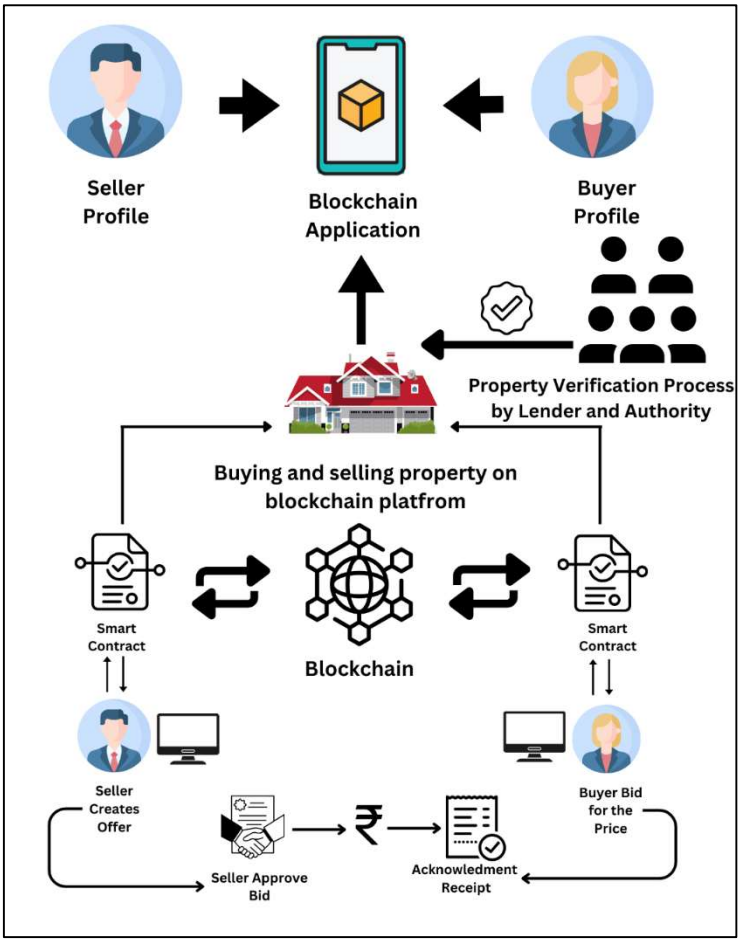


Figure 6: Proposed Model

7. Expected outcome of the research

The research's expected outcome will be effectively attained and will significantly benefit all parties engaged in residential real estate transactions, including the buyer, seller, government, broker and others. The following are others expected outcome:

- The proposed framework facilitates the automation of property transaction processes, hence improving efficiency in these transactions.
- Transaction cost can be reduced by reducing the dependency on intermediaries like brokers and lawyers.
- Blockchain based data driven insights will help government and policy makers to develop more urban and sustainable cities.
- It will assist in achieving SDG 11 i.e., Sustainable Cities and Communities by strengthening urban governance, property management, and property market trust and transparency to make cities inclusive, safe, resilient, and sustainable.

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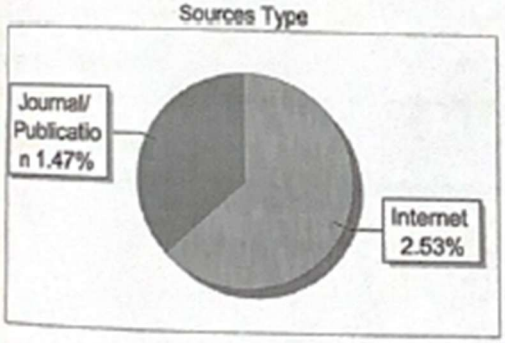

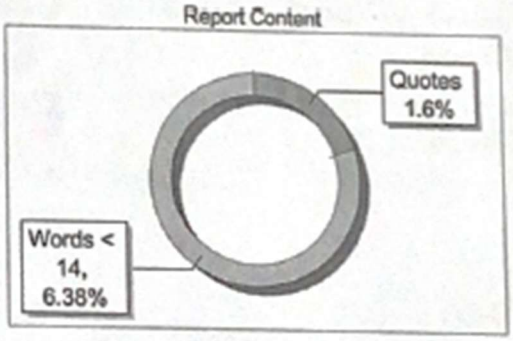

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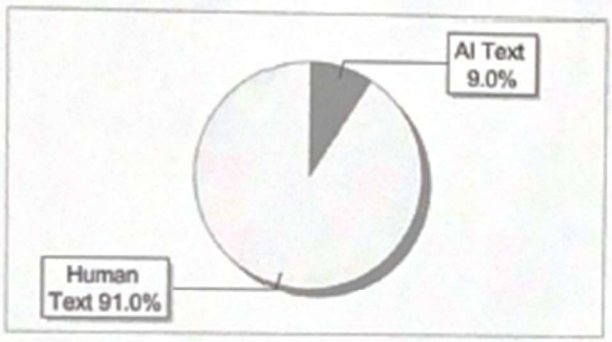

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